SGW-66084
Revision 0

# 200-DV-1 DATA USABILITY ASSESSMENT FOR REPLACEMENT BOREHOLES FOR POLYCHLORINATED BIPHENYLS (PCBS)

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract 89303320DEM000030

CPCCo
Central Plateau Cleanup Company

**P.O. Box 1464**
**Richland, Washington 99352**

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APPROVED
By Janis Aardal at 9:06 am, Mar 31, 2021

Release Approval | Date

# Contents

# Appendix



# Tables

# Terms

| | |
|---|---|
| DQI | data quality indicator |
| DQO | data quality objective |
| DUA | data usability assessment |
| EPA | U.S. Environmental Protection Agency |
| HEIS | Hanford Environmental Information System |
| LCS | laboratory control sample |
| LCSD | laboratory control sample duplicate |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| OU | operable unit |
| PQL | practical quantitation limit |
| QA | quality assurance |
| QC | quality control |
| RPD | relative percent difference |
| SAP | sampling and analysis plan |

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# 1 Introduction

This data usability assessment (DUA) report evaluates laboratory data for soil samples collected during shallow borehole drilling under DOE/RL-2011-104, *Characterization Sampling and Analysis Plan for the 200-DV-1 Operable Unit* (hereinafter called the 200-DV-1 Operable Unit [OU] sampling and analysis plan [SAP]) and the applicable Tri-Party Agreement Change Notice (TPA-CN-0884, *Tri-Party Agreement Change Notice Form: DOE/RL-2011-104, Characterization Sampling and Analysis Plan for the 200-DV-1 Operable Unit, Revision 0*). The data quality indicator (DQI) assessment included in this DUA was used for samples collected under the 200-DV-1 OU SAP and TPA-CN-0884. This DUA completes the U.S. Environmental Protection Agency (EPA) data quality life cycle (planning, implementation, and assessment).

For this project, a judgmental (focused) sampling design was implemented in the field. Therefore, the DQIs of precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity for the specific data sets were evaluated according to EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation*. Data verification and data validation are integral to the DQI evaluation process. The Central Plateau Cleanup Company (CPCCo) used the results of the DQI evaluation process to interpret the data and determine if the data quality objectives (DQOs) for this activity have been met.

This report documents the following components of the DUA:

1. Data verification (Chapter 2)
2. Data validation (Chapter 3)
3. DQI evaluation (Chapter 4)
4. Summary and conclusions (Chapter 6)

## 1.1 Purpose

The purpose of this DUA is to determine whether the data collected under the 200-DV-1 OU SAP (DOE/RL-2011-104) and associated TPA-CN-0884 are the right type and of sufficient quality and quantity to support remediation decisions. The purpose of the 200-DV-1-OU SAP is to provide the quality assurance project plan and field sampling requirements for characterization of the 200-DV-1 OU waste sites. Specific quality control (QC) measures are also provided in this SAP. The purpose of TPA-CN-0884 is to provide locations and sampling depths for two boreholes required to complete polychlorinated biphenyl (PCB) sampling that was not performed as planned under the original SAP.

The DUA process is not intended to be a definitive analysis of a project or problem. Rather, it provides an initial assessment of the reasonableness of the data that have been generated based solely on the QC information associated with the data, and not upon the technical interpretations of the data values.

The information contained in this report follows guidelines for DUAs established by Soil and Groundwater Operations. These project guidelines are based on EPA/240/R-02/004.

## 1.2 Scope

This DUA focuses on the PCB and PCB congener characterization data collected by analyzing soil samples from the shallow vadose zone (0–4.6 m [0–15 ft]) at two borehole locations as outlined in TPA-CN-0884. The data were evaluated to determine whether they meet the analytical criteria outlined in the SAP and are adequate to support decision making. The review determined if the data are the right type, quality, and quantity to support the intended use. The DUA completes the data lifecycle (i.e., planning, implementation, and assessment) initiated by the DQOs process (EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process*).

This DUA covers the following data sets: PCB and PCB congener data from two boreholes (D0208 and D0209) drilled as identified in TPA-CN-0884.

## 1.3 Project Background

This section describes the sampling design and associated project objectives including implementation of the sampling design.

### 1.3.1 Sampling Design

Two new boreholes were drilled per TPA-CN-0884. Soil samples were collected at predefined depths during the drilling of each borehole, as described in TPA-CN-0884 and outlined in Table 1. As discussed in TPA-CN-0884, PCBs were evaluated in the soil samples using a phased approach. First, Aroclors (total PCBs) were evaluated using EPA Method 8082 (SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium*). If Aroclors were not detected in a sample, the sample then was analyzed using EPA Method 1668a to confirm that PCB congeners are either not present or are present at low levels.

**Table 1. 200-DV-1 OU Sample Design**

| Waste Site | Sample Interval (ft bgs) | Analyte |
|---|---|---|
| 216-T-19 Crib and Tile Field | 4-6 | PCBs, PCBs congeners |
| 216-S-13 Crib | 0-2, 2-4, 4-6, 6-8, 8-10, 10-12, 13-15 | PCBs, PCBs congeners |

bgs = below ground surface

### 1.3.2 Project Objectives

Table 2 presents information about principal study questions (PSQs) for 200-DV-1 OU sampling.

**Table 2. Summary of Principal Study Questions for 200-DV-1 OU Shallow Soil Sampling**

| PSQ[a] | Scope of Work | Justification (Data Gap)[b] |
|---|---|---|
| PSQ1a<br>Do chemical and/or radiological contaminants in the shallow (0–4.6 m [15 ft] bgs) vadose zone at 200-DV-1 OU waste sites pose an unacceptable risk to human health and the environment under current and/or potential future land use? | Drill two new replacement boreholes for resampling at the 216-T-19 Crib and Tile Field and 216-S-13 Crib. The shallow boreholes will be offset from the original borehole locations and will be sampled for required analyses not performed in the original boreholes. | During the initial field effort at waste sites 216-T-19 Crib and Tile Field and 216-S-13 Crib, the project inadvertently failed to analyze PCB congeners as a part of the required PCB analyses; therefore, resampling is needed. One borehole at each waste site (216-T-19 and 216-S-13) is needed to collect discrete soil samples from the shallow zone (0–4.6 m [15 ft] bgs) for PCB analysis. |

a. PSQs and data needs are defined in DOE/RL-2011-104, *Characterization Sampling and Analysis Plan for the 200-DV-1 Operable Unit*.
b. Technical justification for Boreholes D0208 and D0209 provided in TPA-CN-0884.

bgs = below ground surface
OU = operable unit
PSQ = principal study question

#### *1.3.2.1 Implementation of the Sample Design*

A review of TPA-CN-0884, the applicable field sampling reports, and applicable analytical data packages indicates that all samples were collected and analyzed in accordance with the sampling design.

Table 3 identifies the sample design implementation and completion for the two 200-DV-1 OU boreholes.

**Table 3. Sample Design Implementation and Completion Evaluation for Two 200-DV-1 OU Boreholes**

| Borehole ID Number | Number of Intervals Sampled | Number Estimated in TPA-CN-0884[a] | Percent of Estimated Number Completed[b] |
|---|---|---|---|
| D0208 | 1 | 1 | 100 |
| D0209 | 7 | 7 | 100 |

a. Estimates for the numbers of samples at each location are presented in TPA-CN-0884.

b. Completed means successfully collected.

ID = identification

## 1.4 QA and QC Requirements

This section describes the analytical and laboratory quality assurance (QA) and QC requirements identified in the 200-DV-1 OU SAP (DOE/RL-2011-104).

### 1.4.1 Laboratory Information

Analysis of samples was performed by Eurofins Test America Knoxville and GEL Laboratories LLC.

Chapters 2, 3, 4, and 5 discuss the analytical data provided by the laboratories.

### 1.4.2 Analytical Methods

Samples were analyzed using methods listed in Table 4. Multi-component method-based analyses were used. Multi-component method-based analyses are those analyses typically based on EPA methods, as applicable, that yield concentration data for multiple analytes in a single analysis. The analytes may include both target analytes and non-target analytes. Sample results were reported in the Hanford Environmental Information System (HEIS) database.

**Table 4. Soil Analytical Methods**

| Parameter | Analytical Method |
|---|---|
| PCBs | EPA 8082 |
| PCB congeners | EPA 1668C |

Note: For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium*.

EPA = U.S. Environmental Protection Agency

PCB = polychlorinated biphenyl

### 1.4.3 Analytical Requirements

Analytical performance requirements for soil samples are defined in TPA-CN-0884. Table 5 summarizes the analytical performance requirements for laboratory analysis of soil samples.

**Table 5. Analytical Performance Requirements for Soil Samples**

| CAS | Analyte | PQL (mg/kg) | Analytical Method[a] | Precision Requirement (%) | Accuracy Requirement (%) |
|---|---|---|---|---|---|
| **Performance Requirements for Laboratory Measurements (organics)** | | | | | |
| 1336-36-3 | PCBs | [b] | EPA 8082 | ≤30[c] | [d] |
| N/A | PCB congeners | 0.00002 | EPA 1668A | ≤30[c] | [d] |

a. Equivalent methods may be substituted. For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium*.

b. The soil PQL for PCBs by EPA Method 8082 is 0.033 mg/kg for all except Aroclor-1016, which has a PQL of 0.333 mg/kg.

c. The precision criteria shown are for batch laboratory replicate sample relative percent differences.

d. The accuracy is statistically derived.

CAS = Chemical Abstracts Service
EPA = U.S. Environmental Protection Agency
N/A = not applicable
PCB = polychlorinated biphenyl
PQL = practical quantitation limit

### 1.4.4 Laboratory QA and QC Requirements

The QA/QC requirements govern nearly all aspects of analytical laboratory operation, including instrument procurement, maintenance, calibration and operation. Laboratory requirements for internal QC checks are performed as appropriate for the analytical method at a rate of one per sample delivery group or 1 in 20 (5%), whichever is more frequent. Laboratory internal QC checks include the following:

- **Laboratory contamination** – As appropriate to the method, each analytical batch contains a laboratory method blank (material of composition similar to that of the samples with known/minimal contamination of the analytes of interest) carried through the complete analytical process. The method blank is used to evaluate false positive results in samples caused by contamination during handling at the laboratory.

- **Analytical accuracy** – A laboratory control sample (LCS) is typically run with every analytical batch. The percent recovery of the LCS is used to evaluate analytical accuracy. In addition, for most analyses, a known quantity of representative analytes of interest (matrix spike [MS]) is added to a separate aliquot of a sample from the analytical batch. The known amount added is compared to the actual measured amount to calculate the percent recovery. The recovery percentage of the added MS is used to evaluate analytical accuracy. For analyses not amenable to MS techniques such as high resolution mass spectrometry or where analytical recovery is evaluated from recovery of the tracers or carriers, the accuracy of the laboratory preparation and analysis evaluation defaults to the LCS.

- **Analytical precision** – Separate aliquots removed from the sample containers (duplicate samples) are analyzed for each constituent as appropriate to the analytical method. The duplicate sample results are compared to the original sample results, which are evaluated as relative percent differences (RPDs) and are used to assess analytical precision. Alternately, a matrix spike duplicate (MSD) may be used for assessing precision. For a MSD, a separate aliquot is removed from the same sample container and spiked in the same manner as the MS. The results, not recoveries, from the MS/MSD are used to calculate a RPD and to assess precision.

Laboratories are also subject to periodic audits of laboratory performance, systems, and overall program. Audits check that the laboratories are performing to laboratory contract requirements. No audits were performed specific to the data analyses performed as part of this project.

#### 1.4.4.1 Qualification Flags

During the generation of environmental analytical data, any of several qualification flags may be assigned to an individual result. The HEIS database carries qualification flags applied by three sources: the laboratory, the third party data validator, or a data user/reviewer. The tables of data within this report show all of these applied qualification flags. Potential flags and their meaning are provided in Table 6.

**Table 6. Qualification Flags**

| Flag | Definition |
|---|---|
| **Laboratory-Applied Flags** | |
| > | WETCHEM – Result greater than quantifiable range or greater than upper limit of the analysis range. |
| * | INORGANICS – Duplicate analysis not within control limits. |
| + | INORGANICS – Correlation coefficient for MSAs is <0.995. |
| A | ORGANICS – Valid for TICs only; the TIC is a suspected aldol-condensation product. |
| B | INORGANICS and WETCHEM* – The analyte was detected at a value <PQL but ≥MDL.<br>ORGANICS – The analyte was detected in both the associated QC blank and in the sample, and the blank concentration exceeded the customer's contractual requirements.<br>RADIONUCLIDES – The associated QC sample blank has a result of ≥2x the MDA; after corrections, result is ≥MDA for this sample. |
| C | INORGANICS and WETCHEM – The analyte was detected in both the sample and the associated QC method blank, and the blank concentration exceeded the customer's contractual requirements.<br>ORGANICS (PESTICIDE only) – The identification of a pesticide confirmed by GC/MS. |
| D | All – Analyte was reported at a secondary dilution factor, typically DF>1 (i.e., the primary preparation required dilution to either bring the analyte within the calibration range or to minimize interference). Required for organics/Wetchem if the sample was diluted. |
| E | INORGANICS – Reported value is estimated because of interference. See comment on cover page, hardcopy case narrative, or specific inorganic hardcopy data sheet. |
| J | ORGANICS – Estimated value: constituent detected at a level <PQL and ≥MDL; estimated concentration of TICs. |
| M | INORGANICS – Duplicate precision criteria not met. |
| N | All (except GC/MS based analysis) – Spike and/or spike duplicate sample recovery is outside control limits.<br>ORGANICS (GC/MS only) – Presumptive evidence of compound based on mass spectral library search. |
| o | All: The laboratory control sample recovery is outside control limits. |
| P | ORGANICS (PCB only) – Aroclor target analyte with >25% difference between column analyses. |
| Q | ORGANICS (dioxins & PCB congeners only) – Estimated maximum concentration. Used if one of the qualitative identification criteria is not met (e.g., chlorine isotopic ratios outside theoretical range.) |
| S | INORGANICS – Reported value determined by the MSA. |
| T | ORGANICS (GC/MS only) – Spike and/or spike duplicate sample recovery is outside control limits. |
| U | All – The constituent was analyzed for and was not detected. The data should be considered usable for decision-making purposes. |
| W | INORGANICS – Post-digestion spike recovery for graphite furnace atomic absorption out of control limit. Sample absorbance <50% of spike absorbance. |

**Table 6. Qualification Flags**

| Flag | Definition |
|---|---|
| X | All – The result-specific translation of this qualifier code is provided in the data report and/or case narrative. Additional result-specific translation information may also be found in the RESULT COMMENT field in HEIS for this record. |
| Y | Same as X if more than one flag is required. |
| Z | Same as X and Y if more than two flags are required. |
| **Third-Party Validation Applied Flags** | |
| UJ | The constituent was analyzed for and was not detected. Because of a QC deficiency identified during data validation, the value reported may not accurately reflect the RL. The data should be considered usable for decision-making purposes. |
| J | Indicates the constituent was analyzed for and detected. The associated value is estimated because of a QC deficiency identified during data validation. The data should be considered usable for decision-making purposes. |
| J+ | Indicates the constituent was analyzed for and detected. The result is an estimated quantity, but the result may be biased high. The data should be considered usable for decision-making purposes. |
| J- | Indicates the constituent was analyzed for and detected. The associated value is estimated with a suspected negative bias due to QC deficiency identified during data validation. The data should be considered usable for decision-making purposes. |
| NJ | The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration. |
| C | The target pesticide or Aroclor analyte identification has been confirmed by GC/MS. |
| X | The target pesticide or Aroclor analyte identification was not confirmed when GC/MS analysis was performed. The data should be considered unusable for decision-making purposes. |
| UR | Indicates the constituent was analyzed for and not detected. However, due to an identified QC deficiency, the data should be considered unusable for decision-making purposes. |
| R | Rejected value: The value may not reflect true concentrations. The ability to establish detection/non-detection may be questionable. Validation activities identified major QC deficiency/ies or sample matrix interferences. The data should be considered unusable for most purposes. Any use of this data should be undertaken with great care. The data should not be used for certain regulatory decision-making purposes. |
| **Data User-Applied Flags** | |
| A | Indicates an issue with the chain-of-custody that could affect data usability. |
| F | Result is undergoing further review. (This review qualifier is assigned when a RDR is first processed.) |
| G | Record has been reviewed and determined to be correct, or the record has been corrected with laboratory confirmation or other supporting information. |
| H | Laboratory holding time exceeded before the sample was analyzed. |
| P | Potential problem. Collection/analysis circumstances make the result questionable. |
| Q | Associated QC sample is out of limits. |
| R | Do not use; further review indicates that the result is not valid. (This review qualifier is used only when there is documented evidence that the result is not valid. Generally, results that are "R" qualified will be excluded from statistical evaluations, maps, and other interpretations.) |
| Y | Result is suspect. Review had insufficient evidence to show result valid or invalid. |

**Table 6. Qualification Flags**

| Flag | Definition |
|---|---|
| Z | Miscellaneous circumstance exists. Additional information may be found in the result comment field (in the HEIS result table) for this record and/or in the sample comment field in the HEIS sample table. |

*Wetchem is a group of analytical methods that are associated with "wet" chemical reactions.

| | | | | | |
|---|---|---|---|---|---|
| DF | = | dilution factor | MSA | = | method of standard addition |
| GC/MS | = | gas chromatograph/mass spectrometer | PQL | = | practical quantitation limit |
| GFAA | = | graphite furnace atomic absorption | QC | = | quality control |
| HEIS | = | Hanford Environmental Information System | RDR | = | request for data review |
| MDA | = | minimum detectable activity | RL | = | reporting limit |
| MDL | = | method detection limit | TIC | = | tentatively identified compound |

### 1.4.5 Field QC Sampling Requirements

TPA-CN-0884 addresses a resampling event to obtain missing sample results. There were no field QC collection requirements for the PCB or PCB congener analysis.

### 1.4.6 Laboratory QC Requirements

A broad review of the laboratory QC results was conducted. Laboratory QC results are stored electronically in HEIS and were evaluated using various database queries against the acceptance criteria. Table 7 provides a summary of the laboratory QC acceptance criteria used.

**Table 7. Laboratory QC Acceptance Criteria**

| QC Element | Acceptance Criteria |
|---|---|
| Laboratory duplicate samples | Laboratory duplicate samples with one or both of the measured concentrations ≥PQL and the RPD is ≤20% for water and ≤30% for solid matrices to be considered acceptable. |
| Laboratory blank samples | If analyte concentration in the laboratory blank is ≥MDL but ≤PQL, no qualification is necessary when the concentration in the associated samples is ≥20x the laboratory blank concentration. |
| LCSs | LCS percent recovery must be between the upper and lower statistical control limits established by the laboratory as required in TPA-CN-0884 and summarized in Table 5. |
| MS/MSDs (where applicable) | Laboratory spikes, where the sample result is ≤4x the spiking concentration are evaluated by comparing the percent recovery with the upper and lower accuracy control limits given in Table 5. In addition, where the sample result is ≤4x the spiking concentration, the MS/MSD RPD must have an RPD ≤30% for solid matrices. Spike values not applicable when sample result is >4x the spiking concentration. |

Reference: TPA-CN-0884.

| | | | | | |
|---|---|---|---|---|---|
| LCS | = | laboratory control sample | PQL | = | practical quantitation limit |
| MS | = | matrix spike | QC | = | quality control |
| MSD | = | matrix spike duplicate | RPD | = | relative percent difference |
| OU | = | operable unit | SAP | = | sampling and analysis plan |

# 2 Data Verification

Data verification is the process of evaluating the completeness, correctness, conformance, and compliance of a specific data set against the method, procedural, or contractual requirements. It includes confirmation that the specified sampling and analytical requirements have been completed (i.e., verification that the number, type, and location of all samples identified in TPA-CN-0884 have been collected and that all required measurements and analyses were performed). This evaluation is documented in the completeness section (Section 4.1.5), which evaluates the sampling design versus field implementation.

## 2.1 Data Verification Results

Data verification requires the evaluation of collected documentation to verify that key information for subsequent validation and DQI evaluations are present.

Data verification is performed in accordance with Sample Management procedures. Final analytical data package verification was performed on a minimum of 25% of randomly selected data deliverables. This random selection is not project specific. For this sample set 100% of the data were verified.

The following sections evaluate and describe the sampling design versus field implementation. All discrepancies between the sampling and analysis requirements outlined in TPA-CN-0884 and what was actually performed are identified. Data verification is performed for field QC and laboratory QC samples.

## 2.2 Field QC

This was a resampling event with no field QC collected or evaluated. There were no specific field QC requirements added in TPA-CN-0884.

## 2.3 Laboratory QC

Laboratory contamination, precision, and accuracy are discussed below.

### 2.3.1 Laboratory Contamination

CPCCo laboratory contracts require that laboratory method blanks be analyzed with each batch of up to 20 samples.

A total of 227 laboratory blank results were reported for the soil samples. Of those blank results, 36 blank results reported detected concentrations above the method detection limit but below the practical quantitation limit (PQL). The 36 blank detections were all associated with one blank sample for PCB congeners and represent 36 different congeners. The highest blank value measured was 0.00505 µg/kg. Due to the very low detection limit achieved by the PCB congener method (from 0.000016 to 0.00505 µg/kg) low level detections are common in both blanks and samples. Third-party validation was performed on 100% of the data in this DUA. The summary of data validation qualification flags (Table 8) lists all the constituents with blank detections and the associated samples that were flagged J+ indicating usable data but with a possible high bias.

**Table 8. Summary of Data Validation Qualification Flags for Soil Samples**

| Analyte(s)[a] | Qualifier[b] | Affected Sample | Reason |
|---|---|---|---|
| **Organics (EPA 1668A PCB Congeners)** | | | |
| PCB-1, PCB-3, PCB-11, PCB-18, PCB-20, PCB-21, PCB-28, PCB-30, PCB-31, PCB-32, PCB-33, PCB-44, PCB-47, PCB-65, PCB-209 | J+ | B3W266 | Laboratory blank contamination |
| PCB-11, PCB-18, PCB-20, PCB-21, PCB-22, PCB-28, PCB-30, PCB-31, PCB-32, PCB-33, PCB-44, PCB-47, PCB-65, PCB-183, PCB-185 | J+ | B3W268 | Laboratory blank contamination |
| PCB-11, PCB-18, PCB-20, PCB-28, PCB-30, PCB-31, PCB-32, PCB-44, PCB-47, PCB-65, PCB-90, PCB-101, PCB-113, PCB-129, PCB-138, PCB-147, PCB-149, PCB-153, PCB-160, PCB-163, PCB-168, PCB-174, PCB-183, PCB-185, PCB-209 | J+ | B3W270 | Laboratory blank contamination |
| PCB-11, PCB-20, PCB-21, PCB-22, PCB-28, PCB-31, PCB-32, PCB-33, PCB-44, PCB-47, PCB-65, PCB-90, PCB-101, PCB-113, PCB-129, PCB-138, PCB-147, PCB-149, PCB-153, PCB-160, PCB-163, PCB-168, PCB-183, PCB-185, PCB-209 | J+ | B3W272 | Laboratory blank contamination |
| PCB-11, PCB-18, PCB-20, PCB-21, PCB-22, PCB-28, PCB-30, PCB-31, PCB-32, PCB-33, PCB-44, PCB-47, PCB-65, PCB-183, PCB-185, PCB-209 | J+ | B3W274 | Laboratory blank contamination |
| PCB-3, PCB-11, PCB-18, PCB-20, PCB-21, PCB-28, PCB-30, PCB-31, PCB-32, PCB-33, PCB-44, PCB-47, PCB-65, PCB-86, PCB-87, PCB-90, PCB-97, PCB-101, PCB-109, PCB-113, PCB-119, PCB-125, PCB-129, PCB-138, PCB-147, PCB-149, PCB-153, PCB-160, PCB-163, PCB-168, PCB-174, PCB-183, PCB-185, PCB-209 | J+ | B3W276 | Laboratory blank contamination |
| PCB-1, PCB-3, PCB-11, PCB-18, PCB-20, PCB-21, PCB-28, PCB-30, PCB-31, PCB-32, PCB-33, PCB-44, PCB-47, PCB-65, PCB-90, PCB-101, PCB-113, PCB-129, PCB-138, PCB-147, PCB-149, PCB-153, PCB-160, PCB-163, PCB-168, PCB-174, PCB-183, PCB-185, PCB-209 | J+ | B3W278 | Laboratory blank contamination |
| PCB-3, PCB-11, PCB-18, PCB-20, PCB-21, PCB-28, PCB-30, PCB-31, PCB-32, PCB-33, PCB-44, PCB-47, PCB-65, PCB-90, PCB-101, PCB-113, PCB-129, PCB-138, PCB-147, PCB-149, PCB-153, PCB-160, PCB-163, PCB-168, PCB-174, PCB-183, PCB-185, PCB-209 | J+ | B3W280 | Laboratory blank contamination |

Note: For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium*.

a. A crosswalk from the PCB number to the IUPAC name and the CAS number is included in Table A-1.

b. Qualifiers are defined in Section 1.4.4.1.

CAS = Chemical Abstracts Service

EPA = U.S. Environmental Protection Agency

IUPAC = International Union of Pure and Applied Chemistry

### 2.3.2 Laboratory Precision

Laboratory precision was determined by the difference between duplicate sample pair results or between MS/MSD sample results. In cases where there is not enough sample an LCS/laboratory control sample duplicate (LCSD) may be substituted for precision determination. Evaluation of the duplicate pairs can only be performed accurately when there is sufficient constituent present to be quantified. Therefore, only RPDs where at least one of the samples in the pair was detected above the PQL were evaluated.

EPA Method 1668A (PCB congeners; SW-846) uses high resolution mass spectrometry. This method does not use, or require, duplicates to determine precision, instead, it uses isotope dilution as part of the QC. All samples had abundance ratios within the acceptance criteria.

For EPA Method 8082 (PCBs; SW-846), a total of 1 MS/MSD pair and 5 LCS/LCSD pairs were evaluated. All RPDs met the acceptance criteria.

### 2.3.3 Laboratory Accuracy

Three types of QC are used to assess accuracy. The LCS is used to assess the accuracy of the laboratory preparation and analysis processes. The MS samples are used to assess the accuracy of the published method on the sample matrix and evaluate matrix effects that may bias the data. Surrogate recoveries can also be used to evaluate method accuracy.

#### *2.3.3.1 Laboratory Control Samples*

A total of 31 LCS results were reported for this sample set. All LCS recoveries satisfied the evaluation criteria.

#### *2.3.3.2 MS Recovery*

MS and MSD recoveries are also used as a measure of analytical accuracy. In cases where the sample concentration is greater than four times the spiking concentration, spike recoveries are not evaluated.

EPA Method 1668A (PCB congeners; SW-846) uses high resolution mass spectrometry. This method does not use or require MSes to determine accuracy; instead, it uses isotope dilution as part of the QC. All isotope dilution acceptance limits were met.

For EPA Method 8082 (PCBs; SW-846), a total of two MS results were evaluated. All spike recoveries met the acceptance criteria.

#### *2.3.3.3 Surrogate Recovery*

Surrogates were analyzed in association with the applicable samples and laboratory QC for both methods. TPA-CN-0884 does not specifically address surrogate acceptance criteria, so the laboratory-established method performance criteria were used for evaluation. A total of 62 results were evaluated. All surrogate recoveries satisfied the analytical method performance requirements.

# 3 Data Validation

Data validation is an analyte- and sample-specific process that extends the evaluation of data beyond method or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set, typically data in single analytical batches. Data validation is an independent assessment to ensure that the reliability of data is known by the user. Analytical data validation provides a level of assurance, based on technical evaluation, that an analyte is either present or absent. Validation includes verification of required deliverables (e.g., the minimum detection limits); evaluation of analytical results based on method blanks and the effect of quality deficiencies on the analytical sample data. Third-party validation was performed on a minimum of 5% of the project data and is described in this chapter.

## 3.1 Data Validation

Data validation was performed by Analytical Quality Associates, Inc. All validation qualifiers resulting from data validation were entered into HEIS.

## 3.2 Data Validation Results

The 200-DV-1 OU SAP (DOE/RL-2011-104) specifies that at least 5% (by matrix and analyte group) of all chemical and radiochemical data must undergo validation. Level C data validation includes the evaluation and qualification of sample results based on:

- MS, LCS, laboratory duplicate, and chemical recovery criteria (as appropriate to the method).
- Field blanks, field duplicates, and field splits (if information is provided) are examined.

Table 9 summarizes the samples and constituents that were independently validated for the 200-DV-1 OU resampling campaign. As shown in Table 9, the 5% 200-DV-1 OU SAP (DOE/RL-2011-104) requirement was exceeded for all constituents.

**Table 9. Validated Soil Sample Summary**

| Analyte | Total Number of Samples Analyzed | Total Number of Samples Validated | Percent Validated |
|---|---|---|---|
| PCBs | 8 | 8 | 100 |
| PCB congeners | 8 | 8 | 100 |

PCB = polychlorinated biphenyl

Percent complete for both methods was 100% with only one minor deficiency identified (discussed below).

### 3.2.1 Major Deficiencies

There were no major deficiencies identified.

### 3.2.2 Minor Deficiencies

A minor deficiency results in qualification of sample data as an estimate; however, the data are considered usable for decision-making purposes.

The PCB congener analysis had a minor deficiency (due to contamination in the blank) which led to some constituent results for all eight samples being qualified as estimates and flagged "J+."

### 3.2.3 Qualification Flags Applied to the Data Set

Table 8 lists the qualification flags applied to the data set as a result of the data validation process.

#### *3.2.3.1 Holding Times and Sample Preservation*

Holding times are defined as the period of time from sample collection to sample analysis or extraction, and the period of time from sample extraction to sample analysis. Holding times are calculated from the date of sample collection as recorded on the chain-of-custody form to determine the validity of the results.

***Soils***. The holding time requirements for PCBs and PCB congeners is analysis within 1 year of sample collection. No specific preservation requirements exist for PCB or PCB congener analysis in soil. All soil samples were properly preserved and analyzed within the prescribed holding times.

# 4 Data Quality Indicator Evaluation

The DQI evaluation process is used to assess data usability for non-statistical (judgmental) sampling designs. Data verification and data validation reports were reviewed to determine the usability of the data set as a whole and the quality of individual results as appropriate in terms of the following DQIs:

- **Precision** – Describe the repeatability of field duplicate data and laboratory QC duplicates (e.g., RPDs of laboratory sample duplicates, LCSDs, and MS/MSDs).

- **Accuracy/Bias** – Discuss evidence of field contamination and laboratory QC (e.g., percent recoveries of LCSes and MSes).

- **Representativeness –** Discuss the extent to which the sampling design was accomplished and the representativeness of the samples and the design as a whole. Identify any specific measurements not representative of the target condition, explain why they are non-representative and discuss the impact to the data set.

- **Comparability –** If multiple laboratories were used or if this data set is intended to be combined with others, discuss the nature of differences that may limit the comparability. For example, note that samples were analyzed using recognized standard methods. If multiple laboratories analyzed field QC split samples, discuss how closely the results agreed between the two laboratories.

- **Completeness** – Discuss the accomplishment of all SAP-required data generating activities. Include a comparison of samples actually collected versus those identified in the original sampling design. Include required field QC blanks, duplicates, and splits in the comparison. Also, compare the analyses performed to the analyses identified in the SAP. Comment on the impact to data set usability of any planned samples that were not taken or analyses not performed.

- **Sensitivity** – Discuss any laboratory data that do not meet the SAP-required reporting limits and other decision thresholds as described in the project DQOs.

## 4.1 Data Quality Indicator Evaluation Results

The DQI evaluation step involves assessing whether the samples collected and the resulting analytical data meet project quality objectives in terms of the DQIs described above. The data verification acceptance rates discussed below are based on the evaluation of QC performance compared to the SAP requirements for the entire data set. Validation acceptance rates are based on the data determined to be valid (i.e., not rejected) in the validated data set.

### 4.1.1 Precision

Laboratory precision is determined by the difference between duplicate sample pair results or between MS/MSD sample results. Data verification results showed an overall precision QC acceptance rate of 100% in the sample set. No results are deemed unusable based on the verification review of precision.

Data validation for the sample set resulted in no qualifications based on precision and show an overall QC acceptance rate of 100% for precision.

### 4.1.2 Accuracy/Bias

Laboratory accuracy is assessed by using three types of QC: LCS, MS/MSD and surrogate recoveries. These QC types are used to determine the accuracy of the laboratory preparation and analysis process and to evaluate matrix effects that may bias the data.

Data verification results for PCB samples showed an overall accuracy QC acceptance rate of 100% based on MS or MSD recoveries. MSes are not used in the PCB congener method. All LCS and surrogate recoveries satisfied the QC criteria. No results are deemed unusable based on the verification review of accuracy. Data validation results show an overall QC acceptance rate of 100% for accuracy in the sample set.

There were no systemic biases identified in this data set other than the known issue of low level detections in both blanks and samples. These detections are the result of the extremely low detection limits associated with the PCB congener method and are commonly observed in data from all laboratories performing this technique.

### 4.1.3 Representativeness

Other than the low level blank detections discussed in the previous section, there were no other issues with this data set. Associated data for all samples are considered valid for decision-making purposes. Overall, the DQIs show the data set to be representative of the sample locations.

### 4.1.4 Comparability

To generate comparable samples, sampling was accomplished using the same procedures used uniformly over the Hanford Site for field sampling. To generate comparable results, laboratory analyses were performed using industry-recognized standard procedures (Table 4).

During the sample analysis period for this data set, the laboratories performing analysis had no systemic analytical issues identified and all labs maintained Washington State accreditation indicating they passed two performance evaluation samples each year.

### 4.1.5 Completeness

All samples estimated for collection, and all required data generating activities outlined in TPA-CN-0884 were completed. All required constituents as outlined in TPA-CN-0884 were reported.

#### *4.1.5.1 Field Blanks*

This was a resample activity, and no field blanks were required in TPA-CN-0884.

#### *4.1.5.2 Field Duplicates*

This was a resample activity, and no field duplicates were required in TPA-CN-0884.

### 4.1.6 Sensitivity

For both the PCB and PCB congener methods, the PQL review was done by confirming that all “J” flagged (detected but below the laboratory PQL) results were below the TPA-CN-0884 PQL requirements listed in Table 5. All PCB Aroclor values met the required PQL values provided in TPA-CN-0884. Of the 1672 PCB congener results reviewed, there were seven results associated with two samples (B3W268 and B3W274) that were “J” flagged with values above the required PQL. Due to the sample matrix issues, there was a sample cleanup step performed on some samples that resulted in the elevated PQLs. The highest of these detections was 0.033 µg/kg and none of these detections impact the usefulness of the results.

## 5 Data Quality Assessment

The 200-DV-1 OU SAP (DOE/RL-2011-104) and associated TPA-CN-0884 are based on a judgmental sampling design which does not require a statistical evaluation of the results.

# 6 Conclusions

Based on the results of this DUA, the sample set is 100% complete as there are no data qualifiers resulting in the rejection of results. Given the high degree of acceptable data, the analytical results are considered usable for their intended purposes as indicated in Chapter 4. Samples were collected and analyzed as specified in the 200-DV-1 OU SAP (DOE/RL-2011-104) and TPA-CN-0884. Sample results accurately indicate the presence or absence of target analyte contamination at sample locations.

Laboratory and matrix accuracy and precision were in control overall and no systematic or general discrepancies were obvious. Sample results appear to be representative of site conditions at the time of collection. Results obtained are comparable to industry standards in that collection and analytical techniques followed approved, documented procedures (except as noted in this report and reflected in qualified data points). All results are reported in industry standard units.

Detection limits, precision, accuracy, and data completeness were evaluated to determine whether any analytical data should be rejected as a result of QA/QC deficiencies. The conclusions of this DUA are that the data that have been collected are of the right type, quality, and quantity for their intended use in the 200-DV-1 OU remedy selection evaluation.

Lastly, the 5% 200-DV-1 OU SAP (DOE/RL-2011-104) requirement for data validation was satisfied for all matrices and analyte groups.

# 7 References

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SW-846 Compendium, 2020, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium*, as updated, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/hw-sw846/sw-846-compendium.

# Appendix A

# PCB Crosswalk

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**Table A-1. PCB Number to IUPAC Name Crosswalk**

| CASRN | PCB Number | IUPAC Name |
|---|---|---|
| 2051-60-7 | 1 | 2-Chlorobiphenyl |
| 2051-61-8 | 2 | 3-Chlorobiphenyl |
| 2051-62-9 | 3 | 4-Chlorobiphenyl |
| 13029-08-8 | 4 | 2,2'-Dichlorobiphenyl |
| 16605-91-7 | 5 | 2,3-Dichlorobiphenyl |
| 25569-80-6 | 6 | 2,3'-Dichlorobiphenyl |
| 33284-50-3 | 7 | 2,4-Dichlorobiphenyl |
| 34883-43-7 | 8 | 2,4'-Dichlorobiphenyl |
| 34883-39-1 | 9 | 2,5-Dichlorobiphenyl |
| 33146-45-1 | 10 | 2,6-Dichlorobiphenyl |
| 2050-67-1 | 11 | 3,3'-Dichlorobiphenyl |
| 2974-92-7 | 12 | 3,4-Dichlorobiphenyl |
| 2974-90-5 | 13 | 3,4'-Dichlorobiphenyl |
| 34883-41-5 | 14 | 3,5-Dichlorobiphenyl |
| 2050-68-2 | 15 | 4,4'-Dichlorobiphenyl |
| 38444-78-9 | 16 | 2,2',3-Trichlorobiphenyl |
| 37680-66-3 | 17 | 2,2',4-Trichlorobiphenyl |
| 37680-65-2 | 18 | 2,2',5-Trichlorobiphenyl |
| 38444-73-4 | 19 | 2,2',6-Trichlorobiphenyl |
| 38444-84-7 | 20 | 2,3,3'-Trichlorobiphenyl |
| 55702-46-0 | 21 | 2,3,4-Trichlorobiphenyl |
| 38444-85-8 | 22 | 2,3,4'-Trichlorobiphenyl |
| 55720-44-0 | 23 | 2,3,5-Trichlorobiphenyl |
| 55702-45-9 | 24 | 2,3,6-Trichlorobiphenyl |
| 55712-37-3 | 25 | 2,3',4-Trichlorobiphenyl |
| 38444-81-4 | 26 | 2,3',5-Trichlorobiphenyl |
| 38444-76-7 | 27 | 2,3',6-Trichlorobiphenyl |
| 7012-37-5 | 28 | 2,4,4'-Trichlorobiphenyl |
| 15862-07-4 | 29 | 2,4,5-Trichlorobiphenyl |
| 35693-92-6 | 30 | 2,4,6-Trichlorobiphenyl |
| 16606-02-3 | 31 | 2,4',5-Trichlorobiphenyl |
| 38444-77-8 | 32 | 2,4',6-Trichlorobiphenyl |
| 38444-86-9 | 33 | 2,3',4'-Trichlorobiphenyl |
| 37680-68-5 | 34 | 2,3',5'-Trichlorobiphenyl |
| 37680-69-6 | 35 | 3,3',4-Trichlorobiphenyl |
| 38444-87-0 | 36 | 3,3',5-Trichlorobiphenyl |

**Table A-1. PCB Number to IUPAC Name Crosswalk**

| CASRN | PCB Number | IUPAC Name |
|---|---|---|
| 38444-90-5 | 37 | 3,4,4'-Trichlorobiphenyl |
| 53555-66-1 | 38 | 3,4,5-Trichlorobiphenyl |
| 38444-88-1 | 39 | 3,4',5-Trichlorobiphenyl |
| 38444-93-8 | 40 | 2,2',3,3'-Tetrachlorobiphenyl |
| 52663-59-9 | 41 | 2,2',3,4-Tetrachlorobiphenyl |
| 36559-22-5 | 42 | 2,2',3,4'-Tetrachlorobiphenyl |
| 70362-46-8 | 43 | 2,2',3,5-Tetrachlorobiphenyl |
| 41464-39-5 | 44 | 2,2',3,5'-Tetrachlorobiphenyl |
| 70362-45-7 | 45 | 2,2',3,6-Tetrachlorobiphenyl |
| 41464-47-5 | 46 | 2,2',3,6'-Tetrachlorobiphenyl |
| 2437-79-8 | 47 | 2,2',4,4'-Tetrachlorobiphenyl |
| 70362-47-9 | 48 | 2,2',4,5-Tetrachlorobiphenyl |
| 41464-40-8 | 49 | 2,2',4,5'-Tetrachlorobiphenyl |
| 62796-65-0 | 50 | 2,2',4,6-Tetrachlorobiphenyl |
| 68194-04-7 | 51 | 2,2',4,6'-Tetrachlorobiphenyl |
| 35693-99-3 | 52 | 2,2',5,5'-Tetrachlorobiphenyl |
| 41464-41-9 | 53 | 2,2',5,6'-Tetrachlorobiphenyl |
| 15968-05-5 | 54 | 2,2',6,6'-Tetrachlorobiphenyl |
| 74338-24-2 | 55 | 2,3,3',4-Tetrachlorobiphenyl |
| 41464-43-1 | 56 | 2,3,3',4'-Tetrachlorobiphenyl |
| 70424-67-8 | 57 | 2,3,3',5-Tetrachlorobiphenyl |
| 41464-49-7 | 58 | 2,3,3',5'-Tetrachlorobiphenyl |
| 74472-33-6 | 59 | 2,3,3',6-Tetrachlorobiphenyl |
| 33025-41-1 | 60 | 2,3,4,4'-Tetrachlorobiphenyl |
| 33284-53-6 | 61 | 2,3,4,5-Tetrachlorobiphenyl |
| 54230-22-7 | 62 | 2,3,4,6-Tetrachlorobiphenyl |
| 74472-34-7 | 63 | 2,3,4',5-Tetrachlorobiphenyl |
| 52663-58-8 | 64 | 2,3,4',6-Tetrachlorobiphenyl |
| 33284-54-7 | 65 | 2,3,5,6-Tetrachlorobiphenyl |
| 32598-10-0 | 66 | 2,3',4,4'-Tetrachlorobiphenyl |
| 73575-53-8 | 67 | 2,3',4,5-Tetrachlorobiphenyl |
| 73575-52-7 | 68 | 2,3',4,5'-Tetrachlorobiphenyl |
| 60233-24-1 | 69 | 2,3',4,6-Tetrachlorobiphenyl |
| 32598-11-1 | 70 | 2,3',4',5-Tetrachlorobiphenyl |
| 41464-46-4 | 71 | 2,3',4',6-Tetrachlorobiphenyl |
| 41464-42-0 | 72 | 2,3',5,5'-Tetrachlorobiphenyl |

**Table A-1. PCB Number to IUPAC Name Crosswalk**

| CASRN | PCB Number | IUPAC Name |
|---|---|---|
| 74338-23-1 | 73 | 2,3',5',6-Tetrachlorobiphenyl |
| 32690-93-0 | 74 | 2,4,4',5-Tetrachlorobiphenyl |
| 32598-12-2 | 75 | 2,4,4',6-Tetrachlorobiphenyl |
| 70362-48-0 | 76 | 2,3',4',5'-Tetrachlorobiphenyl |
| 32598-13-3 | 77 | 3,3',4,4'-Tetrachlorobiphenyl |
| 70362-49-1 | 78 | 3,3',4,5-Tetrachlorobiphenyl |
| 41464-48-6 | 79 | 3,3',4,5'-Tetrachlorobiphenyl |
| 33284-52-5 | 80 | 3,3',5,5'-Tetrachlorobiphenyl |
| 70362-50-4 | 81 | 3,4,4',5-Tetrachlorobiphenyl |
| 52663-62-4 | 82 | 2,2',3,3',4-Pentachlorobiphenyl |
| 60145-20-2 | 83 | 2,2',3,3',5-Pentachlorobiphenyl |
| 52663-60-2 | 84 | 2,2',3,3',6-Pentachlorobiphenyl |
| 65510-45-4 | 85 | 2,2',3,4,4'-Pentachlorobiphenyl |
| 55312-69-1 | 86 | 2,2',3,4,5-Pentachlorobiphenyl |
| 38380-02-8 | 87 | 2,2',3,4,5'-Pentachlorobiphenyl |
| 55215-17-3 | 88 | 2,2',3,4,6-Pentachlorobiphenyl |
| 73575-57-2 | 89 | 2,2',3,4,6'-Pentachlorobiphenyl |
| 68194-07-0 | 90 | 2,2',3,4',5-Pentachlorobiphenyl |
| 68194-05-8 | 91 | 2,2',3,4',6-Pentachlorobiphenyl |
| 52663-61-3 | 92 | 2,2',3,5,5'-Pentachlorobiphenyl |
| 73575-56-1 | 93 | 2,2',3,5,6-Pentachlorobiphenyl |
| 73575-55-0 | 94 | 2,2',3,5,6'-Pentachlorobiphenyl |
| 38379-99-6 | 95 | 2,2',3,5',6-Pentachlorobiphenyl |
| 73575-54-9 | 96 | 2,2',3,6,6'-Pentachlorobiphenyl |
| 41464-51-1 | 97 | 2,2',3,4',5'-Pentachlorobiphenyl |
| 60233-25-2 | 98 | 2,2',3,4',6'-Pentachlorobiphenyl |
| 38380-01-7 | 99 | 2,2',4,4',5-Pentachlorobiphenyl |
| 39485-83-1 | 100 | 2,2',4,4',6-Pentachlorobiphenyl |
| 37680-73-2 | 101 | 2,2',4,5,5'-Pentachlorobiphenyl |
| 68194-06-9 | 102 | 2,2',4,5,6'-Pentachlorobiphenyl |
| 60145-21-3 | 103 | 2,2',4,5',6-Pentachlorobiphenyl |
| 56558-16-8 | 104 | 2,2',4,6,6'-Pentachlorobiphenyl |
| 32598-14-4 | 105 | 2,3,3',4,4'-Pentachlorobiphenyl |
| 70424-69-0 | 106 | 2,3,3',4,5-Pentachlorobiphenyl |
| 70424-68-9 | 107 | 2,3,3',4',5-Pentachlorobiphenyl |
| 70362-41-3 | 108 | 2,3,3',4,5'-Pentachlorobiphenyl |

**Table A-1. PCB Number to IUPAC Name Crosswalk**

| CASRN | PCB Number | IUPAC Name |
|---|---|---|
| 74472-35-8 | 109 | 2,3,3',4,6-Pentachlorobiphenyl |
| 38380-03-9 | 110 | 2,3,3',4',6-Pentachlorobiphenyl |
| 39635-32-0 | 111 | 2,3,3',5,5'-Pentachlorobiphenyl |
| 74472-36-9 | 112 | 2,3,3',5,6-Pentachlorobiphenyl |
| 68194-10-5 | 113 | 2,3,3',5',6-Pentachlorobiphenyl |
| 74472-37-0 | 114 | 2,3,4,4',5-Pentachlorobiphenyl |
| 74472-38-1 | 115 | 2,3,4,4',6-Pentachlorobiphenyl |
| 18259-05-7 | 116 | 2,3,4,5,6-Pentachlorobiphenyl |
| 68194-11-6 | 117 | 2,3,4',5,6-Pentachlorobiphenyl |
| 31508-00-6 | 118 | 2,3',4,4',5-Pentachlorobiphenyl |
| 56558-17-9 | 119 | 2,3',4,4',6-Pentachlorobiphenyl |
| 68194-12-7 | 120 | 2,3',4,5,5'-Pentachlorobiphenyl |
| 56558-18-0 | 121 | 2,3',4,5',6-Pentachlorobiphenyl |
| 76842-07-4 | 122 | 2,3,3',4',5'-Pentachlorobiphenyl |
| 65510-44-3 | 123 | 2,3',4,4',5'-Pentachlorobiphenyl |
| 70424-70-3 | 124 | 2,3',4',5,5'-Pentachlorobiphenyl |
| 74472-39-2 | 125 | 2,3',4',5',6-Pentachlorobiphenyl |
| 57465-28-8 | 126 | 3,3',4,4',5-Pentachlorobiphenyl |
| 39635-33-1 | 127 | 3,3',4,5,5'-Pentachlorobiphenyl |
| 38380-07-3 | 128 | 2,2',3,3',4,4'-Hexachlorobiphenyl |
| 55215-18-4 | 129 | 2,2',3,3',4,5-Hexachlorobiphenyl |
| 52663-66-8 | 130 | 2,2',3,3',4,5'-Hexachlorobiphenyl |
| 61798-70-7 | 131 | 2,2',3,3',4,6-Hexachlorobiphenyl |
| 38380-05-1 | 132 | 2,2',3,3',4,6'-Hexachlorobiphenyl |
| 35694-04-3 | 133 | 2,2',3,3',5,5'-Hexachlorobiphenyl |
| 52704-70-8 | 134 | 2,2',3,3',5,6-Hexachlorobiphenyl |
| 52744-13-5 | 135 | 2,2',3,3',5,6'-Hexachlorobiphenyl |
| 38411-22-2 | 136 | 2,2',3,3',6,6'-Hexachlorobiphenyl |
| 35694-06-5 | 137 | 2,2',3,4,4',5-Hexachlorobiphenyl |
| 35065-28-2 | 138 | 2,2',3,4,4',5'-Hexachlorobiphenyl |
| 56030-56-9 | 139 | 2,2',3,4,4',6-Hexachlorobiphenyl |
| 59291-64-4 | 140 | 2,2',3,4,4',6'-Hexachlorobiphenyl |
| 52712-04-6 | 141 | 2,2',3,4,5,5'-Hexachlorobiphenyl |
| 41411-61-4 | 142 | 2,2',3,4,5,6-Hexachlorobiphenyl |
| 68194-15-0 | 143 | 2,2',3,4,5,6'-Hexachlorobiphenyl |
| 68194-14-9 | 144 | 2,2',3,4,5',6-Hexachlorobiphenyl |

**Table A-1. PCB Number to IUPAC Name Crosswalk**

| CASRN | PCB Number | IUPAC Name |
|---|---|---|
| 74472-40-5 | 145 | 2,2',3,4,6,6'-Hexachlorobiphenyl |
| 51908-16-8 | 146 | 2,2',3,4',5,5'-Hexachlorobiphenyl |
| 68194-13-8 | 147 | 2,2',3,4',5,6-Hexachlorobiphenyl |
| 74472-41-6 | 148 | 2,2',3,4',5,6'-Hexachlorobiphenyl |
| 38380-04-0 | 149 | 2,2',3,4',5',6-Hexachlorobiphenyl |
| 68194-08-1 | 150 | 2,2',3,4',6,6'-Hexachlorobiphenyl |
| 52663-63-5 | 151 | 2,2',3,5,5',6-Hexachlorobiphenyl |
| 68194-09-2 | 152 | 2,2',3,5,6,6'-Hexachlorobiphenyl |
| 35065-27-1 | 153 | 2,2',4,4',5,5'-Hexachlorobiphenyl |
| 60145-22-4 | 154 | 2,2',4,4',5,6'-Hexachlorobiphenyl |
| 33979-03-2 | 155 | 2,2',4,4',6,6'-Hexachlorobiphenyl |
| 38380-08-4 | 156 | 2,3,3',4,4',5-Hexachlorobiphenyl |
| 69782-90-7 | 157 | 2,3,3',4,4',5'-Hexachlorobiphenyl |
| 74472-42-7 | 158 | 2,3,3',4,4',6-Hexachlorobiphenyl |
| 39635-35-3 | 159 | 2,3,3',4,5,5'-Hexachlorobiphenyl |
| 41411-62-5 | 160 | 2,3,3',4,5,6-Hexachlorobiphenyl |
| 74472-43-8 | 161 | 2,3,3',4,5',6-Hexachlorobiphenyl |
| 39635-34-2 | 162 | 2,3,3',4',5,5'-Hexachlorobiphenyl |
| 74472-44-9 | 163 | 2,3,3',4',5,6-Hexachlorobiphenyl |
| 74472-45-0 | 164 | 2,3,3',4',5',6-Hexachlorobiphenyl |
| 74472-46-1 | 165 | 2,3,3',5,5',6-Hexachlorobiphenyl |
| 41411-63-6 | 166 | 2,3,4,4',5,6-Hexachlorobiphenyl |
| 52663-72-6 | 167 | 2,3',4,4',5,5'-Hexachlorobiphenyl |
| 59291-65-5 | 168 | 2,3',4,4',5',6-Hexachlorobiphenyl |
| 32774-16-6 | 169 | 3,3',4,4',5,5'-Hexachlorobiphenyl |
| 35065-30-6 | 170 | 2,2',3,3',4,4',5-Heptachlorobiphenyl |
| 52663-71-5 | 171 | 2,2',3,3',4,4',6-Heptachlorobiphenyl |
| 52663-74-8 | 172 | 2,2',3,3',4,5,5'-Heptachlorobiphenyl |
| 68194-16-1 | 173 | 2,2',3,3',4,5,6-Heptachlorobiphenyl |
| 38411-25-5 | 174 | 2,2',3,3',4,5,6'-Heptachlorobiphenyl |
| 40186-70-7 | 175 | 2,2',3,3',4,5',6-Heptachlorobiphenyl |
| 52663-65-7 | 176 | 2,2',3,3',4,6,6'-Heptachlorobiphenyl |
| 52663-70-4 | 177 | 2,2',3,3',4,5',6'-Heptachlorobiphenyl |
| 52663-67-9 | 178 | 2,2',3,3',5,5',6-Heptachlorobiphenyl |
| 52663-64-6 | 179 | 2,2',3,3',5,6,6'-Heptachlorobiphenyl |
| 35065-29-3 | 180 | 2,2',3,4,4',5,5'-Heptachlorobiphenyl |

**Table A-1. PCB Number to IUPAC Name Crosswalk**

| CASRN | PCB Number | IUPAC Name |
|---|---|---|
| 74472-47-2 | 181 | 2,2',3,4,4',5,6-Heptachlorobiphenyl |
| 60145-23-5 | 182 | 2,2',3,4,4',5,6'-Heptachlorobiphenyl |
| 52663-69-1 | 183 | 2,2',3,4,4',5',6-Heptachlorobiphenyl |
| 74472-48-3 | 184 | 2,2',3,4,4',6,6'-Heptachlorobiphenyl |
| 52712-05-7 | 185 | 2,2',3,4,5,5',6-Heptachlorobiphenyl |
| 74472-49-4 | 186 | 2,2',3,4,5,6,6'-Heptachlorobiphenyl |
| 52663-68-0 | 187 | 2,2',3,4',5,5',6-Heptachlorobiphenyl |
| 74487-85-7 | 188 | 2,2',3,4',5,6,6'-Heptachlorobiphenyl |
| 39635-31-9 | 189 | 2,3,3',4,4',5,5'-Heptachlorobiphenyl |
| 41411-64-7 | 190 | 2,3,3',4,4',5,6-Heptachlorobiphenyl |
| 74472-50-7 | 191 | 2,3,3',4,4',5',6-Heptachlorobiphenyl |
| 74472-51-8 | 192 | 2,3,3',4,5,5',6-Heptachlorobiphenyl |
| 69782-91-8 | 193 | 2,3,3',4',5,5',6-Heptachlorobiphenyl |
| 35694-08-7 | 194 | 2,2',3,3',4,4',5,5'-Octachlorobiphenyl |
| 52663-78-2 | 195 | 2,2',3,3',4,4',5,6-Octachlorobiphenyl |
| 42740-50-1 | 196 | 2,2',3,3',4,4',5,6'-Octachlorobiphenyl |
| 33091-17-7 | 197 | 2,2',3,3',4,4',6,6'-Octachlorobiphenyl |
| 68194-17-2 | 198 | 2,2',3,3',4,5,5',6-Octachlorobiphenyl |
| 52663-75-9 | 199 | 2,2',3,3',4,5,5',6'-Octachlorobiphenyl |
| 52663-73-7 | 200 | 2,2',3,3',4,5,6,6'-Octachlorobiphenyl |
| 40186-71-8 | 201 | 2,2',3,3',4,5',6,6'-Octachlorobiphenyl |
| 2136-99-4 | 202 | 2,2',3,3',5,5',6,6'-Octachlorobiphenyl |
| 52663-76-0 | 203 | 2,2',3,4,4',5,5',6-Octachlorobiphenyl |
| 74472-52-9 | 204 | 2,2',3,4,4',5,6,6'-Octachlorobiphenyl |
| 74472-53-0 | 205 | 2,3,3',4,4',5,5',6-Octachlorobiphenyl |
| 40186-72-9 | 206 | 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl |
| 52663-79-3 | 207 | 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl |
| 52663-77-1 | 208 | 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl |
| 2051-24-3 | 209 | Decachlorophenyl |

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